Effects of Weight and Dimension Regulations: Evidence from Canada

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ABSTRACT

In this paper the following questions are examined: (a) How has the makeup and use of Canada's fleet of large trucks been affected by differences in and changes to weight and dimension regulations? (b) Has the use of larger trucks led to increases in shipment sizes? (c) How and to what extent has the for-hire trucking industry passed on productivity gains to shippers in the form of reduced rates? Information sources include registration data, roadside survey data, Statistics Canada's survey of shipments, and actual industry tariffs. The conclusions are that, as expected, different regulations in different jurisdictions and changing regulations do have an impact on fleet characteristics, shipment size, and trucking rates. However, the precise nature and extent of these impacts is complex and not readily predictable. For example, the evidence indicates that relaxing weight and dimension regulations in the western provinces led to the steady introduction of double-trailer combinations in the trucking fleet but that the rate of introduction varied significantly between intraprovincial and extraprovincial operations, among different provinces, and between for-hire and private carriers. Similarly, the evidence suggests that there were highly varied impacts on shipment sizes and for-hire trucking rates. There have been rate savings of up to 33 percent directly attributable to the use of larger vehicles for certain commodity movements; in other cases there have been little or no savings.

Canada is an ideal laboratory for analyzing the effects of weight and dimension regulations: first, cross-sectionally, each of Canada's 12 provinces and territories is responsible for and has promulgated its own, sometimes quite distinct, regulations and, second, the regulatory situation has been significantly relaxed over the last 15 years. In this paper a number of different data sources are used to examine the effect of these regulations on the characteristics of the trucking fleet, the average size of truck shipments, and trucking rates. Although there are few simple answers to the questions that may be posed, some partial evidence is beginning to emerge in Canada as a result of an on-going research effort.

REGULATORY SETTING

The regulatory setting for vehicle weights and dimensions in Canada is complex. This has resulted from a division of jurisdictional responsibility among federal, provincial, and local governments; different transportation problems and requirements in various regions; and different engineering problems and practices. In this paper only key aspects of the current "basic" regulations and recent changes to these regulations can be summarized. The term "basic" refers to the weight and dimension regulations applicable to major highways during the summer season (no spring reductions or winter weight premiums) and to most trucks (excluding trucks operating under exemptions or special permits).

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In 1970 maximum dimensions were more or less uniform across the country: 102-in. widths, 13.5-ft heights, 35- or 40-ft lengths for single vehicles and 65-ft combination lengths. With one major exception, maximum axle weights and gross vehicle weights (GVWs) were also relatively uniform: The general standard was 18, 32, and 74 kips for single axles, tandem axles, and GVWs, respectively. The major exception was in Ontario where triple axles were allowed a load of 40 kips and GVWs of 116 kips were permitted.

In 1971 Ontario moved even further away from the relatively uniformity in the rest of the country by adopting the Ontario bridge formula as the basis for regulating vehicle weights and dimensions. In its original form, this new approach permitted 20, 35, and 44 kips on single, tandem, and triple axles and a maximum GVW of 135.5 kips (1). The Ontario bridge formula introduced a greater degree of flexibility into the design of large truck combinations, which permits an almost infinite variety of configurations, axle spacings, and load-distribution options. In addition, the introduction of the bridge formula spurred a rapid period of adjustment and "catch-up" in other regions: between 1971 and 1973 Newfoundland, New Brunswick (major highways), Quebec, British Columbia, and the Yukon all increased allowable axle and gross vehicle weights significantly.

The next major change was the Western Canada Highway Strengthening Program. As a result of this program, in 1974 the three prairie provinces replaced their single, tandem, and GVW limits of 18, 32, and 74 kips with 20, 35, and 110 kips on primary highways. This permitted standard five-axle tractor-semitrailers to operate on major routes at 80 kips (assuming 10-kip steering axles); increased payload capacity by 6 kips; and permitted double-trailer combinations (doubles) with six or seven (sometimes eight) axles to be used effectively on major routes

at GVWs of up to 110 kips, thus handling weight-out payloads of up to 80 kips or nearly double the previous maximum of 45 kips.

In 1978, as a result of another highway strengthening program, the Atlantic provinces adopted as minimum 20-, 40-, and 110-kip single, tandem, and GVW limits (37.5 kips on tandem-drive axles) for all major highways. An important aspect of this change was the adoption of the 110-kip GVW limit in Nova Scotia (it had previously had the most restrictive limits) permitting the effective use of doubles throughout the region.

In 1982 the prairie provinces further increased GVW limits on primary highways to 118 kips in Alberta and Saskatchewan and 125 kips in Manitoba. In addition, GVW limits on most secondary highways were increased to 108 kips (from 74). This change permitted doubles on primary highways to register at the full GVW limits obtained by summing allowable axle weights (seven axles in Saskatchewan and Alberta and eight in Manitoba) and increased payload capacity by 8 kips (15 in Manitoba). It also permitted doubles to be used effectively off the primary highway network. This use of doubles on secondary roads was significant in that much of the region's bulk commodity movements (grain, fertilizer, lumber) originate or terminate, or both, off the primary system (2).

Throughout this period important increases in allowable combination lengths were introduced in most jurisdictions, replacing the 65-ft limit with limits of up to 75.5 ft (given certain further conditions depending on the jurisdiction). These changes were made to facilitate the use of long wheelbase tractors in the double-trailer combinations that were emerging.

Given these changes, Canada's current basic regulations can be summarized as follows: (a) Doubles can now be used effectively across the country, albeit at GVW limits that range from a low of 110 kips in Nova Scotia (seven axles) to a high of 140 kips in Ontario, British Columbia, and the Yukon (eight and sometimes nine axles); (b) there are no meaningful variations in height (13.5 ft) or width (8.5 ft) limits; (c) overall combination length limits vary considerably, but doubles of 75.5 ft can now be operated in all provinces and territories from Quebec to the West; (d) steering-axle weight limits vary from 12 to 20 kips; (e) nonsteering, single-axle weight limits vary from 18 to 22 kips; (f) tandem-axle limits vary from 35 to 44 kips; (g) western Canada prohibits the effective use of triple axles (restricting them to tandem-axle limits) whereas central and eastern Canada permit their use at load levels greater than tandem-axle limits; and (h) western Canada generally prohibits the effective use of "belly" axles (nonsteering single axles in the middle of trailer units, generally capable of being raised when not needed) whereas these can be used effectively in Ontario and several other eastern provinces.

This is a highly condensed description of Canada's weight and dimension regulations, but it provides sufficient background against which some of their effects can be described. Further details on these regulations are provided elsewhere (3-5). In addition to these basic limits, and the road-class and seasonal variations on them, all provinces allow overdimension or overweight trucks, or both, under exemptions or special permits. These trucks are a growing component of Canadian trucking but are not considered here.

TRUCK FLEET CHARACTERISTICS

There is no complete information base that can be used to characterize Canada's fleet of large trucks. Three regional and partial sources have been used here: registration data for the prairie provinces, on-road survey data, and a survey of industry officials. Although these sources do not provide directly compatible information, together they provide strong indications of how trucking operations have adapted to various regulatory regimes and changes in those regimes.

Western Canada

Registration Data

The 1974 regulatory changes permitted higher GVW levels on existing five-axle combinations by increasing axle weights on primary highways. Further, six- to eight-axle doubles could be used effectively on primary highways in place of the then standard (typically five-axle) tractor-semitrailer units. The 1982 change, which increased GVW limits on the region's secondary highway system, extended the opportunity to use doubles in most trucking activities on the prairies.

The information given in Table 1 is the proportion of nonresident private, for-hire, and total (private plus for-hire) tractors registered in each of the three prairie provinces from 1973 to 1984 at GVW levels that imply the use of configurations of six or more axles (doubles). On the basis of the information presented in this table and other data (6), there are a number of observations that can be made about the effects of the 1974 and 1982 regulatory changes.

First, trucking operators steadily introduced six- to eight-axle doubles (compared with a sudden large increase). For example, for the fleet represented in Table 1 (extraprovincial nonresident vehicles), in 1974 there were no six- to eight-axle doubles in the three prairie provinces. Two years later, 2 to 3 percent of the fleet had been registered at double-trailer weight levels; 10 years after the change, 30 to 38 percent of the nonresident tractor registrations in the three provinces were at weight levels that imply double-trailers. Considering intraprovincial vehicles and data provided elsewhere (6), the rate of introduction of doubles in the region varied from a level roughly similar to that for extraprovincial operations (Manitoba) to half that rate (Saskatchewan). There are several possible explanations for these different rates of introduction of doubles into the fleet: (a) differences in the extent and nature of secondary highways in each of the three provinces, (b) differences in local demand conditions, and (c) differences in the trucking industry within each province.

Second, for-hire carriers have introduced doubles more rapidly than private truck operators. Referencing the nonresident fleet information given in Table 1, in the early years of the relaxed weight regulations there was not much difference in the proportion of doubles introduced into the for-hire and private extraprovincial fleets. By 1980-1981, however, one of every five (nonresident) for-hire tractors was registered at double-trailer weight levels versus one in ten private tractors. By 1983-1984, these ratios had changed to (roughly) two of every five for-hire tractors versus one of five private tractors.

Third, the majority of the new doubles registered in the region required a minimum of seven axles; they were 3-S2-2(3) or 3-S1(S2)-3 A-trains or 3-S2-S2 B-trains. The remainder were registered at weight levels that require only six axles and were typically 3-S1-2 A-trains. ("3-S2-2" indicates vehicle combinations and number of axles; "S" indicates a fifth wheel; an A-train consists of a semitrailer and a

TABLE 1 Proportion of Nonresident Private (P), For-Hire (F), and Total (T) Tractors Registered at GVW Levels Implying Double Trailer Operation in Manitoba, Saskatchewan, and Alberta, 1973-1984

	Manitoba			Saskatchewan			Alberta		
	P	F	T	P	F	T	P	F	T
1973-1974	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]
1975-1976	5	2	3	1	2	3	–	–	–
1977-1978	6	7	6	–	–	–	–	–	–
1978-1979	8	14	12	–	–	–	–	–	–
1979-1980	11	15	14	–	–	–	–	–	–
1980-1981	12	20	18	10	21	20	–	–	–
1982-1983	17	29	25	18	34	29	17	32	28
1983-1984	20	34	30	20	40	34	21	42	38

Note: Dashes = no data.
[a]Effective use of doubles was prohibited.

full trailer; a B-train consists of two semi-trailers.) In 1983-1984, 85 percent of the doubles registered in all three provinces for extraprovincial operations were registered at weights that require seven or more axles.

On-Road Surveys

On-road truck surveys measure actual vehicle characteristics on the road as distinct from registered fleet characteristics. There are important differences between these two indicators of fleet characteristics. For example, a carrier might register a tractor at 118 kips for use in a seven-axle A-train configuration but operate it in both this configuration and as a standard five-axle tractor-semitrailer (by dropping the pup trailer) depending on the available payload.

The information given in Table 2 is based on an unpublished vehicle classification analysis of on-road surveys conducted at three of Manitoba's permanent weigh scales for the years 1974 to 1984. There are four observations concerning the effect of the 1974 and 1982 changes in regulations. First, three- and four-axle tractor-semitrailers (single-drive axle tractors) have been virtually eliminated as of 1984 at all scale sites, including the international border crossing at Emerson.

Second, at two scale sites along the Trans-Canada Highway (Westhawk and Headingly), doubles began to appear soon after the 1974 regulatory adjustment. Such units accounted for 1 to 2 percent of all tractor-trailer combinations in 1974 and steadily increased to 12 to 13 percent by 1981 to 1982. As of 1984 they accounted for 17 percent of the combinations observed at Westhawk. This is approximately one-half of the proportion of doubles that would have been expected on the basis of vehicle registration data.

Third, fleet changes at the Emerson scale site (international border) have been limited to the disappearance of three- and four-axle tractor-semitrailers and the introduction of a small proportion of doubles. The small employment of seven- and eight-axle doubles through this site is to be expected because they could not be used effectively in the United States (given an 80-kip GVW limit in Minnesota). A relaxation of the GVW limit in the United States could lead to a fairly rapid adoption of seven- and eight-axle doubles on this international route because such units are now well established in the Manitoba fleet and the traffic lane is dominated by the movement of weight-out bulk commodities (grain, potash, lumber, etc.) (7).

Fourth, A-train configurations have dominated the double-trailer units in Manitoba, and the nature of these A-trains has changed over time. Initially, they were primarily five- and six-axle units, which suggests that cube-out rather than weight-out operations were the first to take advantage of the relaxed regulations. This was followed by a shift to a more or less equal proportion of six- and seven-axle units, coupled with the demise of single-drive-axle tractors and increased opportunities for using doubles in handling weight-out commodities. Finally, there has been a more recent shift to seven- and

TABLE 2 Classification of Observed Laden Tractor-Trailer Configurations at Permanent Weigh Scale Sites in Manitoba (shown as % of all such combinations observed)

Vehicle Type	Westhawk Scale					Headingly Scale				Emerson Scale			
	1974	1975	1978	1981	1984	1974	1975	1978	1982	1974	1975	1978	1981
2-S1	1	*	*	*	*	2	1	*	*	*	*	*	*
2-S2	5	8	6	5	1	9	6	4	3	4	2	*	*
2-S3	*	0	*	0	*	0	*	0	0	0	0	0	0
3-S1	*	*	*	0	0	0	*	*	*	0	0	0	0
3-S2	90	86	85	79	80	86	89	87	84	95	96	99	96
3-S3	2	2	1	2	*	*	*	*	1	*	*	0	0
2-S1-2	*	1	*	*	*	2	1	*	*	*	*	0	*
2-S2-2	*	*	*	0	0	0	0	0	0	0	0	0	0
3-S1-2	*	1	3	5	5	*	*	3	3	0	*	0	0
3-S1-3	0	0	*	2	4	0	0	1	*	0	0	0	0
3-S2-2	0	*	2	3	4	0	*	3	4	0	0	0	3
3-S2-3	0	*	*	2	4	*	*	*	1	0	0	0	0
3-S2-S2	0	0	*	*	1	0	0	*	3	0	0	0	*
Observations	559	726	831	812	545	1,181	1,012	996	994	686	458	670	482

Note: * signifies this vehicle type accounted for > 0% but < 1% of observations. Westhawk scale, Trans-Canada Highway, Manitoba-Ontario border, observed interprovincial trucking; Headingly scale, Trans-Canada Highway, west of Winnipeg, local and long-distance trucking; and Emerson scale, located at the Manitoba and North Dakota/Minnesota border [see Clayton and Sem (7)].
Source: Manitoba Department of Highways and Transportation, unpublished truck survey data.

eight-axle units (the effective use of eight-axle units was impossible before the 1982 relaxation of the GVW limit in Manitoba). B-train configurations were not observed in Manitoba until 1978, and today they appear to account for only about 5 percent of the doubles used in interprovincial movements between Manitoba and eastern Canada and about one-quarter of the doubles used west of Winnipeg. (The 1982 regulatory adjustment in Manitoba permitted A-trains to handle greater payloads than B-trains; as a result, the use of B-trains is discouraged.)

On-road survey data collected in Saskatchewan (8,9) and Alberta (10,11) from the early 1970s to the present show trends similar to those in Manitoba. Some minor differences in the trends and further observations based on these surveys include the following: (a) In Saskatchewan there is a higher proportion of doubles observed on the road than in Manitoba (nearly 30 percent versus the 17 percent on the Trans-Canada Highway in Manitoba) and this higher proportion in Saskatchewan is closer to the figures suggested by vehicle registration data; (b) in Alberta the evidence suggests that during the past 11 years the use of straight trucks has declined, the use of large configurations (doubles, truck-trailers, and triples) has increased, and the use of the standard five-axle tractor-semitrailers has remained relatively constant; (c) although the rate of introduction of doubles into the Saskatchewan and Alberta fleets was relatively steady (as in Manitoba), there was one sharp increase in Alberta 4 years after the regulatory change; and (d) by 1981 6.3 percent of all trucks observed in Alberta (including those weighed empty) had payloads of 60,000 lb or more.

Ontario: On-Road Surveys

Ontario's regulations (based on its bridge formula) have given rise to a variety of vehicle types quite unique to Ontario, and in particular six-or-more-axle single- and double-trailer combinations using various types of triple- and belly-axle arrangements. For example, Ontario is one of only two provinces where it is feasible to operate tractor-semitrailers up to 75.5 ft long, and it is one of the few places where tractor-semitrailers with as many as nine axles can be seen on a regular basis (no special permit is required).

On-road surveys provide some indication of how Ontario's truck fleet developed between 1978 and 1983 (12). In 1978 only 2 percent of the tractor-trailers observed on Ontario's highways were doubles; 98 percent were single semitrailers. In 1983 doubles accounted for (at least) 5.5 percent of observed tractor-trailers split more or less evenly between A- and B-trains; single-trailer units accounted for 93.3 percent of the observed tractor-trailer fleet; and the remaining 1.3 percent involved a mixture of combinations not easily classified.

Of more interest is the distribution of Ontario's tractor-trailers by number of axles, which illustrates some of the unique characteristics of this fleet. The standard 3-S2 configuration accounts for three-quarters of the tractor-semitrailer class; triple- and multiaxle semitrailer combinations (with six or more axles) account for another nearly 20 percent). About half of Ontario's doubles have eight or more axles, which suggests weight-out operations, and B-trains (typically 3-S3-S2) are somewhat more prevalent than A-trains [presumably 3-S2(S3)-3(2) arrangements]. The other half of the observed doubles had seven or fewer axles, which suggests cube-out operations.

Canada-Wide: Survey of Industry Officials

A survey of truck operators was carried out in 1984 to provide an indication of the relative popularity of different configurations operating in different regions across the country (13). In British Columbia, doubles account for 40 percent of tractor-trailer combinations. Four of every five of these are A-trains (dominated by 3-S1-2 and 3-S2-3 configurations); the remainder are B-trains (nearly always a 3-S2-S2 or a 3-S2-S3 with a belly axle). Doubles account for only 2 percent of the tractor-trailer fleet in New Brunswick. Tractor-semitrailers account for 98 percent of the fleet; four of every five of these are the 3-S2 configuration and 15 percent are six-axle units (most with a belly axle). Two regulatory considerations that have contributed to this low utilization of doubles in this region are the 65-ft combination length limits and the relatively recent (1978) increase in axle and GVW limits. In Quebec doubles account for 10 percent of the tractor-trailer fleet; four of every five are A-trains [essentially all are 3-S2-3(4) configurations], and the remainder are B-trains (nearly always a 3-S3-S2 arrangement). Tractor-semitrailers account for 90 percent of Quebec's tractor-trailer fleet; three-quarters of these are 3-S2 configurations and 20 percent have six axles and use either triple-axle or belly-axle arrangements. (This is only a partial summary of the survey.)

SHIPMENT SIZE

An analysis has been made of average shipment sizes based on the annual survey of for-hire shipping documents conducted by Statistics Canada (14). The object of this analysis was to determine if more relaxed weight and dimension regulations resulted in larger shipments. That is, the hypothesis being tested was that as the trucking industry adopted larger vehicles, some of the productivity savings would show up in the form of larger shipments at correspondingly lower rates per unit of weight. The analysis encountered a series of problems in trying to isolate the effects of weight and dimension regulations from those of the many other factors at work; nevertheless, on the basis of the findings of this work (4), some relevant observations have emerged.

The first attempt to analyze the data indicated that there was an apparent trend between 1976 and 1980 in Canada to larger truckload (TL) shipment sizes and that most of this trend was accounted for by intraprovincial shipments. In a second attempt, using data from 1976 to 1981 and based on a frequency distribution of shipment sizes in each province or territory, it appeared that the distribution of shipments within particular weight categories changed from year to year independent of any particular change in weight and dimension regulations. This is important (and probably intuitively obvious) because it emphasizes the point that not all the differences (in time or between jurisdictions) can be attributed to weight and dimension regulations.

Notwithstanding this observation, the frequency distribution of shipments by size did reveal a clear difference between the "high-weight" provinces (particularly Ontario and Quebec) and the "low-weight" provinces. For example, in 1976, less than 1 percent of shipments of crude materials (e.g., sand and gravel) in either Nova Scotia or Manitoba was in the "over 60 kip" category; in Ontario, 65 percent of these shipments were in the "over 60 kip" category. Clearly, there is a difference in shipment sizes in

these provinces that is related to different allowable weight regulations (in 1976 the permitted maximum GVW in Nova Scotia was 80 kips; in Manitoba the new 110-kip limit on primary highways was only beginning to have an effect on shipment size; and in Ontario the 135-kip limit had been in effect for some time).

Considering the change in shipment sizes over time, there was a reasonably clear trend toward larger shipments in those provinces that adopted more permissive weight and dimension regulations in the 1970s. For example, in 1976 only 0.8 percent of crude materials in Manitoba were in the "over 60,000 lb" category; by 1981, 24.2 percent of these shipments were in this weight category. (The important change in weight regulations occurred in 1974.)

Further in the analysis (the definition of TL was changed slightly), it was determined that the average weight of intraprovincial TL shipments in the low-weight provinces was in the range of 42 to 46 kips, whereas the average weight in the high-weight provinces was in the range of 50 to 54 kips. There were, however, few clear trends over time (an exception was the case of Nova Scotia). Considering extraprovincial shipments, there was a general tendency toward larger shipments in all provinces. In the case of extraprovincial traffic, of course, regulations of several provinces have an influence, which makes it difficult to trace the causal links. Between 1976 and 1981 extraprovincial TL shipments in Canada increased in average size by 3,000 to 5,000 lb.

Although there was only a preliminary examination of revenues per ton-mile in the analysis, it was enough to show the large difference shippers paid for small TL shipments versus large TL shipments. For example, in 1980 TL shipments of lumber moving 320 to 360 mi cost a shipper 5.95 cents per ton-mile if the shipment weighed between 20 and 30 kips whereas the cost dropped to 2.15 cents per ton-mile if the shipment weighed between 70 and 100 kips.

Since this work [reported elsewhere (4)] was done, more recent data have been published by Statistics Canada (15). These new data permit the analysis to be extended to include 1982. Unfortunately the 1976 to 1980 data are published in imperial units and the 1981 to 1982 data are published in metric units; as a result the weight breaks used do not correspond, and only a rough idea of the increase in shipment sizes can be gleaned. The following figures show the proportion of large TL shipments in 1982 with the comparable 1976 figure shown in parentheses (large in 1976 is 50,000 lb or more out of all shipments weighing 20,000 lb or more; large in 1982 is 20 tonnes or more out of all shipments weighing 10 tonnes or more): Newfoundland and Prince Edward Island, 66.9 percent (versus 27.0 percent in 1976); Nova Scotia, 70.7 percent (38.9 percent); New Brunswick, 69.0 percent (50.0 percent); Quebec, 58.1 percent (42.2 percent); Ontario, 63.3 percent (46.6 percent); Manitoba, 61.6 percent (19.0 percent); Saskatchewan, 49.2 percent (29.5 percent); Alberta, 59.4 percent (29.3 percent); and British Columbia and the territories, 62.9 percent (48.5 percent). For all of Canada, 61.0 percent of TL shipments were large in 1982 versus 42.4 percent in 1976. Clearly, and overlooking the imperfections in the measurements, there has been a significant increase in the size of TL shipments.

TRUCK COSTS AND RATES

The purpose of relaxing weight and dimension regulations is to allow larger and heavier trucks to haul freight more efficiently (more payload per unit of input) thereby producing a lower cost service for shippers. The potential productivity advantages of larger vehicles have been extensively examined in the literature (16,17). In Canada it has been shown that moving freight in seven- or eight-axle doubles versus standard five-axle tractor-semitrailers provides per unit payload cost advantages of 7 percent for cube-out traffic and 15 to 42 percent (increasing with GVW) for weight-out traffic (18). However, knowing what advantages larger vehicles can potentially offer is one thing; knowing in fact what advantages result from permitting their use is another (e.g., are the savings actually realized and passed on to shippers?).

Comprehensive data on the actual effect of weight and dimension regulations on rates are difficult to obtain. In the preceding section information on revenue per ton-mile showed that larger shipments move at lower rates than smaller ones; this is close to demonstrating the effect of weight and dimension regulations, but it does not sort out all the factors. Some case study research has been done in Canada (3) and the results of this work plus some extensions made by the authors can be used to show the impact of the Western Canada Highway Strengthening Program. (There are problems using a case study approach; various qualifications to this work are being overlooked here.)

Saskatchewan: Petroleum Rates

Rates for the intraprovincial movement of bulk petroleum are regulated by the Saskatchewan Highway Traffic Board. Most movements take place in TL quantities from refineries or distribution centers to retail outlets. The following observations illustrate how Saskatchewan's weight and dimension regulations, and changes in these regulations since 1974, have been reflected in these rates. The specific numbers discussed are based on a case involving 100-mi hauls, assigned traffic, and carrier-provided equipment.

First, weight and dimension changes since 1974 have led to the progressive introduction of more and larger minimum-shipment-size lots with attendant relative decreases in rates. Before 1974 there was one TL rate for shipments of 40 to 45 kips handled at the then maximum allowable GVW of 74 kips. In February 1975 a 52-kip minimum shipment rate (relevant for the new 80-kip GVW limit for 3-S2 units on primary highways) was introduced that provided an 8 percent rate differential over the 46-kip minimum shipment rate (relevant for the same unit operating on secondary highways at a GVW of 74 kips). In December 1976 a 72-kip rate (relevant for seven-axle A- and B-trains on primary highways) was introduced that provided a 16 percent differential compared with the 46-kip minimum rate. In the spring of 1982 two additional shipment lots were introduced (69 and 78 kips) that are relevant for the new GVW limits for doubles on the secondary (108 kips) and primary (118 kips) highways, respectively.

Second, the size of the rate differentials has progressively increased, which suggests that the potential cost savings associated with larger shipments took time to be fully realized, understood, and passed on to the shipper. For example, the differential on a TL lot for a 3-S2 unit on a primary versus secondary highway in 1975 was 8 percent and rose to 12 percent by 1983. Similarly, the differential between a primary highway double-trailer lot versus a secondary highway 3-S2 unit lot was 16 percent in 1976 and rose to 23 percent in 1983.

Third, the size of the minimum shipments applicable to various types of units increased throughout the period, which indicates either progressive decreases in average tare weights or improved loading experience. For example, the minimum shipment size relevant for a standard 3-S2 unit operating on primary highways increased from 52.0 kips (1975) to 52.3 kips (1980) and then to 53.5 kips (1983).

Industry sources indicate that, today, 90 to 95 percent of all intraprovincial petroleum movements occur in double-trailer lots at the 75- or 78-kip rates. This suggests that shippers could be realizing a total saving of up to 25 percent in freight costs as a result of the 1974 and 1982 increases in weight limits. A number of institutional and industry considerations unique to this case have influenced the strong linkage between weight limit increases and rate decreases. First, the shippers involved (oil companies) are few in number, powerful in their dealings with the truckers, and more knowledgeable than most shippers about trucking costs. Second, the truckers in this business operate in a very competitive environment and regularly face the threat of the private carriage option. Third, the presence of an intermediary regulatory agency has created a continuous search for "logic" in the rate structure ("the rates must reflect the fact that larger trucks result in unit cost savings").

Manitoba: Petroleum Rates

Rates for the movement of petroleum products within and to or from Manitoba are set by the carriers. The 1975 to 1980 tariffs established by one of the major carriers involved in this business have been examined for evidence of change in response to the 1974 regulatory adjustment. For illustrative purposes, rates on two movements are considered in the following observations (an intraprovincial movement from Winnipeg to Brandon and an extraprovincial movement from Regina to Brandon).

Double-trailer lot rates for minimum payloads of 73.2 kips (implying a 110-kip GVW operation) were first introduced 4 years after the relaxed weight limits were implemented (and nearly 2 years after an equivalent rate was introduced in Saskatchewan). The differential between the 74- and the 80-kip GVW rates is on the order of 5 to 6 percent compared with the Saskatchewan differential of nearly 10 percent. The differential between the 110-kip GVW double-trailer lot rates and the 80-kip GVW single-trailer lot rates is very similar to that implemented in Saskatchewan during the same time period. As happened in Saskatchewan, this differential increased with time from 8 to 10 percent to nearly 14 percent in 1980.

Central-Western Canada: General Freight Rates

This section is a report on an analysis of rates published by the Canadian Transport Tariff Bureau Association (CTTBA) from 1971 to the present for certain commodity movements between central and western Canada. This is an extension of results presented elsewhere (3). Such an analysis is open to error or misinterpretation, or both. Tracing problems occur because of changes over time in tariff numbers and in detailed commodity descriptions within a tariff. The mere existence of a rate under one item in one tariff is no assurance that the analyst is looking at an "important" transportation price. For example, rates for "Meat--Fresh, Hanging" may become less important as the rate for "Meat--Fresh, Boxed" becomes more important, or a rate in one tariff may be meaningless given the existence of "independent actions." These qualifications must be borne in mind in considering the following observations.

The first CTTBA rate considered is for "Brass, Bronze or Copper: Bars, Pipes, Sheets, Tubing." Rates have been analyzed on three lanes (Toronto to Calgary, Winnipeg, and Regina). Before October 1974, 40 kips was the largest minimum shipment size rate and was available on all three lanes. This rate would be relevant for a five-axle tractor-semitrailer operating at the old 74-kip GVW limit. In October 1974 a 50-kip minimum rate was introduced on the Toronto-Winnipeg lane only; this rate would be relevant for the same five-axle unit operating at the newly permitted 80-kip GVW limit. The 50-kip rate has been retained in the tariff for the Winnipeg movement to the present, whereas on the Regina and Calgary lanes the largest minimum shipment rates are still at 40 kips. No "train-lot" (75-kip) rate has been introduced into the tariff.

The October 1974 tariff established the following (approximate) relationships between different rates on the three lanes:

	Ratio of X-kip Rate to 40-kip Rate			
	20:40	30:40	40:40	50:40
Toronto to Calgary	1.21:1	1.07:1	1:1	n.a.
Regina	1.18:1	1.08:1	1:1	n.a.
Winnipeg	1.22:1	1.09:1	1:1	0.94:1

These ratios have remained stable through a series of rate adjustments, except for the 50:40-kip ratio on the Toronto-Winnipeg lane. This ratio has decreased from 0.942 (September 1977), to 0.903 (October 1977), to 0.871 (April 1979), to 0.855 (October 1979), to 0.784 (March 1980), to 0.720 (March 1981), and finally to 0.672 (April 1982). The extent to which the differential between the 50- and 40-kip rates has developed (now nearly 33 percent) is much greater than could be expected from unit cost savings comparing 3-S2 operations at 80 and 74 kips. This suggests that the 50-kip rate is typically used for much larger payloads, in particular payloads of maybe 75 to 80 kips, which are relevant to double-trailer operations at 110+-kip GVWs.

The second CTTBA rate considered, under a number of tariffs, is for "Iron and Steel" moving from southern Ontario to western Canada. From 1971 to the present, in the "all-member" tariff, the largest minimum shipment lot is 40 kips, which suggests no development in response to relaxed weight regulations. However, most westbound iron and steel moves under independent actions: individual carriers file their own rates, typically at levels substantially lower than the all-member rates. One of these filings has, at least since April 1983, provided rates for five minimum shipment lot sizes: 45, 60, 70, 80, and 100 kips. There is an important condition attached to the 100-kip lot rates requiring a volume commitment (essentially an agreed charge). The 45-kip rate suggests payloads that could be handled in standard 3-S2 units, and the 60-, 70-, and 80-kip rates suggest double-trailer operations not permitted before the 1974 weight change. The 80-kip rate is about 16 percent lower than the 45-kip rate.

The 100-kip rate is 28 percent lower than the 45-kip rate; however, it is a rate that requires a payload that cannot be handled on the Manitoba leg of the trip (where the maximum GVW is 125 kips). There are three possible explanations for the existence of this 100-kip rate: (a) the carrier may be "breaking" the double close to the Manitoba-Ontario border and using two tractors into Winnipeg, (b) the carrier may be operating overload in Manitoba, or (c) the carrier may break the load into two units at the

origin and top-up with other traffic. Industry sources indicate that the third scenario is most likely, and this point helps to explain one of the realities of the impact of relaxed regulations on trucking in general. As suggested by these sources, the more permissive regulations have strengthened the competitive position of truck vis-à-vis rail, and this has been exercised by capturing "base" loads of heavy commodities, splitting them, and topping them up with more lucrative traffic. Such practices would be difficult to measure in the field and would have been difficult to predict before the regulatory change.

The third CTTBA rate considered is the new "Pup-Load Charge," a direct consequence of the increased weight limits. Rates are filed on a commodity-specific basis for the use of a pup independent of the payload (up to the pup's GVW potential). For example, as of April 1985, the rates for the movement of "synthetic resin articles" from Calgary to Toronto were $5.50 per hundredweight (20+ kips), $4.77 per hundredweight (40+ kips), and $1,378.00 for a pup load. Assuming a linear weight of 1,000 lb per foot and a 27-ft pup, the pup-load charge is equivalent to $5.10 per hundredweight. At 1,500 lb per foot, the equivalent rate is $3.40 per hundredweight. Thus, given a high-density payload, the use of doubles (two 27-ft pups, each with a payload of 40.5 kips) would offer a saving of about 29 percent.

Other CTTBA rates analyzed were for "Fresh Meat--Suspended" and "Seeds: Field, Grass, Mustard." In neither case could any evidence be found that the changing weight and dimension regulations had affected rates.

Saskatchewan: Intraprovincial General Merchandise Rates

Rates for intraprovincial movements of general merchandise [typically less-than-truckload (LTL) general freight] are regulated. At present the tariff is a prescribed maximum. The lowest rate in the tariff has been applied to a gradually increasing minimum shipment size over time as the regulations have permitted larger trucks. This relatively decreasing rate is irrelevant, however, because the evidence suggests that 99 percent of all shipments moving under this tariff are small shipments. In those isolated instances in which general merchandise is moved in large shipments (40+ kips), actual rates are undoubtedly less than the prescribed maximums.

The major impact of the relaxed regulatory environment on these intraprovincial general merchandise rates is associated with the total payload-handling capabilities of the larger vehicles rather than with the maximum shipment size that can be handled. To this effect, since 1979, the LTL general merchandise rates have been derived from a cost model that incorporates a payload parameter: the greater the payload, the lower the unit cost, the lower the unit rate. However, there is evidence to suggest that larger payloads and lower rates have not materialized simply because the underlying demand conditions cannot support larger payloads (given the same service frequency).

Western Canada: Selected Dry Bulk Commodity Rates

Cement, grain, and fertilizer are three significant dry bulk commodities handled by trucks within the prairie region. Each of these is a weight-out rather than a cube-out product and as such has been an obvious candidate for servicing at higher GVW limits. Several observations can be made about the impact of relaxed weight and dimension regulations on these movements.

Considering bulk cement movements, as of June 1974, TL rates from Winnipeg to points in Saskatchewan, Manitoba, and western Ontario were based on a 36-kip minimum shipment. In early 1977 the minimum shipment size was increased to 48 kips. In early 1982 a rate reduction of 10 percent from the 48-kip rate was introduced for double-trailer lots (110-kip GVW) with a minimum payload of (about) 73 kips. There has been no further differential introduced in response to the 1982 weight limit increases. Two factors have apparently discouraged more extensive use of double-trailer lot rates for the movement of this product: (a) storage capacity restrictions at the receiving points and (b) a reluctance on the part of the shippers to introduce pricing practices that would lead to differences in the delivered unit price between a consignee who accepted a single-trailer lot versus one who accepted a double-trailer lot.

Commercial grain-hauling rates in western Canada have generally been insensitive to shipment size (19). The industry thinks in terms of a 48-kip (plus or minus) "normal" minimum shipment size. Such a load can be handled by a standard five-axle unit, even at secondary highway axle weight limits. However, as of 1982, some truckers have introduced double-trailer lot rates that assume approximately 77-kip loads. These rates are typically 10 to 15 percent lower than the quoted semitrailer lot rates. Although this may appear to contradict the observation that rates have been insensitive to shipment size, the "discounted" double-trailer rates fall within the same range as those actually being paid to the competing semitrailer operators. The market is relatively unsophisticated (many small shippers and truckers), highly competitive, and very fluid. All rates, no matter what is quoted or what equipment is used, tend to normalize at certain levels.

Tariffs for fertilizer published by two major distributors indicate that, as of the fall of 1982, a 48-kip (plus or minus) minimum was the only minimum shipment lot rate provided (19). Possible explanations for this apparent insensitivity to the relaxed regulatory situation are (a) the highly peaked nature of the demand for fertilizer movements, with the result that trucking services are offered in a sellers' market and (b) the general reluctance of farmers to take delivery of fertilizer in double-trailer lots.

CONCLUSIONS

Clearly, different weight and dimension regulations and changing weight and dimension regulations affect the characteristics of the large truck fleet, the size of shipments, and the cost or rate of the trucking service. It is also clear that the precise nature of these impacts is complex. Given Canada's experience, it would be extremely simplistic to subscribe to the view that more permissive regulations instantaneously "cause" large trucks to appear on the roads with larger payloads, larger shipments, and lower rates.

The truth is that the exact consequences of different or changed weight and dimension regulations are difficult to predict:

- What segment of the trucking industry will respond (for-hire/private, bulk commodity/general freight)?
- What will the time lags be (instantaneous, several years as some of the evidence suggests, or longer)?
- What types of commodity or hauling situations

are more critical under different regulatory scenarios (dense weight-out or less dense cube-out commodities)?

- Why do changes in some jurisdictions appear to encourage A-trains instead of B-trains (or is this largely a matter of the type of operating condition or flexibility required by carriers)?
- Why do trucking rates for some commodity and hauling situations appear to respond relatively rapidly and significantly to changes in weight and dimension regulations while others do not?
- Why does the spread between the "old" TL rates and the "new" double-trailer rates appear to increase over time for some hauling situations but not for others?

Developing convincing assessments of alternative weight and dimension regulations will require answers to these and other questions. Although the evidence discussed in this paper obviously provides some partial answers, it also raises many more questions.

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